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Commercial Vine Crop Production in Alberta

(pickling and slicing cucumbers, pumpkin and squash)

Vine crops, members of the Cucurbitaceae family, grow best in areas where high temperatures prevail. Most species of this group also require a long growing season. Commercial production of vine crops is concentrated in southern Alberta, with some species grown successfully in most regions of the province.

The production recommendations for all species of vine crops are similar. When special cultural practices apply, they will be dealt with in detail separately under each crop.

Varieties

Variety recommendations may vary from year to year; therefore, reference should be made to the current issue of the Alberta Vegetable Production Guide. Market requirements for each crop differ and some varieties fulfill these requirements better than others do. Variety trials are conducted at Alberta Agriculture research centres in Brooks and Edmonton for the benefit of producers. The results of the trials are made available to producers every year. Consult with one of the provincial vegetable specialists before making seed purchases.

Cucumbers

In recent years, there have been tremendous strides made in cucumber breeding. The development of hybrids has led to improvements in both yield and quality and also disease resistance.

Cucumber varieties are usually classified according to their use: fresh market or pickling. Fresh market varieties are generally referred to as slicing cucumbers, the fruits of which are larger and develop a darker, heavier skin. Pickling varieties tend to develop shorter vines than slicing varieties. The seed cavity of pickling varieties also develops more slowly, which is an important characteristic affecting their suitability for storage in brine.

Cucumber varieties can also be classified according to spine color. Varieties with white spines retain their green color longer as immature fruit and become a dull ivory yellow when fully ripe. Black-spined varieties develop a dull orange color at full maturity and tend to turn color prematurely under high field temperature conditions. Because of this characteristic, black-spined varieties are better suited to Alberta, where summer temperatures are relatively cool. Black-spined cucumbers are preferred over white-spined varieties because they develop a more attractive color after prolonged storage in brine.

The development of hybrids has produced a proliferation of varieties with differing flower habits

Monoecious (MF) - These varieties produce both male and female flowers on the same plant and are extremely viney, with generally poor yields in comparison to the amount of vine produced. This group tends to be the most tolerant to variable weather conditions. Monoecious hybrids have the advantage of developing a larger plant before fruit sets and also of setting fewer fruit at any one time, thus permitting them to develop higher quality fruit.

Gynoecious - True gynoecious varieties bear only female flowers, therefore a pollinator is added at a rate of 10 to 15 per cent of the hybrid seed to ensure satisfactory fruit set. When a seed package is opened, the pollinator and gynoecious hybrid are identified by the different colored fungicide applied to each kind of seed. Several classes of gynoecious hybrids are available:

- semi-gynoecious (SF) - between gynoecious and monoecious

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- gynoecious (F) - plants produce only female flowers

- predominantly gynoecious (PF) - plants may produce male flowers during early stages of flower development after which they produce only female flowers.

To fully benefit from the earlier production and higher yield potential in gynoecious hybrids, some of the environmental influences on flowering habit need to be understood. Gynoecious hybrids seem to have the least stability for production of female flowers under conditions of environmental stress. Fewer female flowers will be produced when:

- prolonged periods of stress including extremes of temperature, lack of soil moisture, low nitrogen availability, overcrowding and poor light conditions exist.

- a heavy fruit load exists because several female flowers are pollinated at about the same time; fruit load stress results in poorly shaped fruits, which increases the percentage of culls.

Both pickling and slicing cucumbers suffer from a condition called "first fruit" inhibition. In other words, the first fruit set on the vine inhibits other fruit further down the vine from developing. The production of auxin, a hormone, in the developing seeds is responsible for this behavior. Plant breeders have recently been successful in breeding out this behavior in slicing cucumbers by producing seedless varieties. There parthenocarpic varieties do not produce seed and therefore do not stop producing fruit if left unharvested. To prevent seed production, they must not cross pollinate with non-parthenocarpic varieties and there must be at least 100 feet separating them. Floating mulches, polyester spunbonded covers, effectively prevent pollination of any kind which is not required to produce fruit in parthenocarpic varieties.

Recent breeding developments in slicing cucumbers have emphasized proper color development, correct shape, a fine smooth skin that is free of spines, vigorous growth, high crop certainty, multiple disease resistance and good keeping quality after harvest. Burpless varieties do not produce cucurbitacin, a compound that makes cucumbers taste bitter when grown under stress. Spineless varieties have been tested in Brooks, however, commercial acceptance may be a problem because fruit tends to be light green and fruit length of less than 15 cm (6 in.) is too short to meet grade standards. Bush varieties, of value to home gardeners only, are not high yielders. This compact vine growth is a result of genetic control over the distance between nodes, which greatly reduce vine extension between each leaf (where a node is located).

Pumpkin

The breeding of new pumpkin varieties has not received the attention that cucumber breeding has. All varieties are monoecious, that is, they produce both male and female flowers on the same plant. Hybrids of both vining and bush types have been developed that are earlier in maturity and produce a higher yield of quality fruit. Bush varieties produce short vines with very short internodes. Fruit set occurs in close succession on the vine. Bush varieties tend to set a fruit load that is too heavy for the amount of leaf area available, consequently there is not enough photosynthetic product available to supply all the fruit and some fruit may abort. Dry matter and sugar content can be lower and more variable than on vining varieties. Hybrid vine hybrids have a more favorable leaf to fruit ratio. In vining types there is a tendency toward female flower production along main stems progressing from base to tip. This results in a heavier concentration of fruit near the root, similar to what occurs in bush varieties.

Recent developments have produced varieties in which fruit exhibit a yellow pigmentation early in development. This trait helps to distinguish fruit maturity because fruit turns a bright orange when fully ripe.

Hull-less varieties produce seed that has no true seed coat. Hull-less seeds are used in the food snack industry. These varieties do have shortcomings. When planted in the field, the seed has a tendency to rot and consequently germination is poor. Furthermore, either the fruit flesh becomes inedible or the yield of seed from each fruit is low.

Ornamental pumpkins, both minature and gourd-like fruited varieties have helped open new markets. Destined for the Thanksgiving market, the fruit have limited shelf-life beyond Christmas. The plants tend to be very viney in relation to their production of fruit.

Pumpkins are best classified according to fruit shape:

Ornamental - Small and decorative fruits that have no culinary quality.

Sugar or pie - These medium-sized fruit tends to be flat in shape; it is fine grained and sweet, making it the best for pies.

Carving - The fruit are large and oblong to round in shape, the texture is coarser. These fruit are ideal for the Halloween market.

Processing - These very large fruit are coarse in texture and have poor culinary quality; most varieties are late maturing.

Squash - summer and winter

The simplest method of differentiating summer squash from winter squash is by the stage of fruit development at harvest. Summer squash are harvested when they are immature; winter squash can be harvested when the fruit are mature. All squash are monoecious, producing both male and female flowers on the same plant.

Summer and winter squash are available in a wide range of colors and shapes. These characteristics are commonly used to group varieties into types.

Summer Squash

Italian - the most popular type in the market, these fruit are long, smooth and cylindrically shaped with a slight swelling at the blossom end; yellow and various shades of green fruit are available; the market prefers green fruit; zucchini and marrows which are often called Lebanese squash fall into this class.

Straightneck - The fruit shape is similar to that of Italian except for a tapering toward the stem end; only pale yellow fruit are available.

Crookneck - The fruit have a slightly elongated bulb at the blossom end and a moderately crooked neck; only pale yellow colored fruit are available.

Scallop - The fruit look like a flattened semi-globe, somewhat tart shaped with a scallop margin; pale green and yellow fruit are available.

Winter Squash

Acorn - The fruit are deeply ridged and acorn shaped; green, yellow or white fruit are available; they are often called pepper squash.

Buttercup - Fruit are turban shaped, with or without a prominent knob; orange and green fruit are available.

Spaghetti - The uniform cylindrically shaped fruit have a spaghetti-like pulp; ivory to mottled pale orange fruit are available.

Banana - The very large elongated fruit are pink when mature; retailers cut and wrap fruit pieces in cellophane to make them marketable.

Hubbard - The fruit are round, pointed at the blossom end with a small hump at the stem end; the surface is rough; green, orange or blue fruit are available.

Delicious - Large, heart-shaped fruit with a dark orange color are available. The surface of the fruit is smooth to the touch.

Ornamental - The fruit are small and round with a flat-topped teacup shape; only ivory colored fruit with dark green stripes are available.

Others - The butternut and sweet potato squash types do not mature in Alberta and are not recommended.

Most winter squash belong to one of three different species. Pumpkin is included in one of the species. Each species has distinct qualities related to culinary value and storability.

C. pepo This species includes: all the summer squash varieties; pumpkins; winter squash types including acorn, spaghetti and ornamental squash. This species can have a delicate, delicious flavor with a smooth texture; the interior color is usually pale. Pepo species of winter squash appear to store well, remaining sound, however, the eating quality deteriorates gradually in a few months resulting in a bland and stringy textured flesh.

C. maxima This species includes the hubbard, buttercup (with and without knob), banana and delicious types. *C. maxima* is the most cold tolerant of all squashes. Winter squash in this species have the sweetest and most fibre-free flesh. The interior color is dark rather than bright; most are good keepers.

C. moschata This species includes squash such as the butternut and sweet potato, which are not recommended in Alberta. They are the least cold tolerant species and require more heat to mature than *C. maxima* and *C. pepo*.

Bush characteristics have also been bred into squash. All summer squash types have a bush habit; of the winter types, only a few acorn and buttercup produce fruit on bushy plants. This vegetative bush habit concentrates the fruit near the heart of the plant, which makes the harvest of fruit easier. The compact growth habit also allows for higher density plantings.

Recent developments have produced varieties of acorn squash that yield yellow fruit in both the mature and immature fruit stage. The immature fruit can be eaten as a summer squash.

Soil Requirements

Vine crops will not tolerate wet, poorly aerated soils. Well drained soils with a high level of sand are preferred because they warm up more readily in the spring and encourage vigorous growth. Well drained soils are even more important for pumpkin and winter squash crops because the fruit lies in contact with the soil for a long time. Cold, poorly drained soils will encourage fruit rot.

A 3- to 4-year crop rotation is recommended to prevent a serious problem with Sclerotinia, a fruit rot organism that can destroy a pumpkin and winter squash crop. Additionally, crop rotation will help keep the land relatively free of weeds. Vine crops are not good weed competitors.

Fertilizer

Vine crops have a large, shallow root system that forages over an extended area. High nitrogen levels are needed to promote vegetative growth which in turn is the main source of plant assimilates (food) required to stimulate fruit set and growth. Phosphorous is required for fruit growth. In winter squash, adequate levels of available phosphorus are needed to enhance storability of fruit.

An excess of nitrogen has been shown to encourage fruit rot both in the field and in storage. Excess nitrogen also delays maturity in pumpkin and winter squash, often causing fruit to be soft, lopsided or flattened. Nitrogen levels must be closely monitored under irrigation due to leaching of the nutrient and also due to increased nutrient needs in high density plantings.

Although no specific field trials have identified the exact nutrient needs, the following amounts should be available at the beginning of the growing season: 30 kg/ac of nitrogen , 50 kg/ac of phosphorous , and 80 kg/ac of potassium. In sandy soils, half the required nitrogen should again be applied as a sidedress application in late June or early July.

Seeding

Vine crops are very sensitive to low temperature, therefore early spring seeding is not recommended. For Alberta, mid-May in the southern region and late May in central and northern regions are the preferred seeding dates. By this date, the soil temperatures should have reached at least 15°C at a 1 cm ($\frac{1}{2}$ in.) depth. At this soil temperature, emergence occurs much more quickly and there is less chance for damping-off to occur. Another common problem surfacing each spring is chilling injury. Young seedlings with fully developed cotyledon leaves turn white when temperatures approach freezing. Experience has shown that so long as the emerging new leaves are not damaged and low temperatures do not persist, the seedlings will recover. In some situations producers have re-seeded to compensate for reduced plant stands caused by damping-off or chilling injury. To ensure that both maturity and good yields are realized, re-seeding of cucumbers and summer squash should not take place after mid-June, pumpkin and winter squash not after late May.

Several types of seed drills are currently used by producers in Alberta, including modified sugar beet plate seeders and walking sticks (jab planters), which are used to plant squash and pumpkin. Others of a more complex nature include Stanhay precision drills, cyclo corn planters that operate on a drum principle, plug-mix planters used to seed through plastic mulch and most recently the Gaspardo SP 520, which is a precision vacuum seeder. The Stanhay does not do a particularly good seeding job with any of the vine crops because of the difficulty of fitting an oblong seed into a round hole. When using a Stanhay, the required smooth rubber seed belt cut with a single line of holes spaces seed as follows:

summer squash - 6 holes - seed drop every 30 cm (1 ft)

cucumbers - 20 holes - seed drop every 7-10 cm (3-4 in.)

A single-rib rubber belt is needed for pumpkin and winter squash seed:

pumpkin, winter squash - 3 holes - seed drop every 1.2-1.5 m (4-5 ft)

The Stanhay does seed a little heavier than desired so some thinning may be required. The plug-mix planter can be adjusted to drop seed at 15 cm (6 in.) intervals and up in increments of 15 cm (6 in.). Seed is blended with fine peatmoss in a ratio of 6 to 10 ounces of seed for every 4-cubic-foot bag of fine peatmoss. The ratio applies to a 15 cm (6 in.) seed drop interval and will require five 4-cubic-foot bags to plant an acre. Seed is blended with the fine peat and water may be added to moisten the mixture with the objective of planting pre-germinated seed to speed up seedling emergence. The plug-mix planter is not a precision drill and clumping of seed (more than one seed per station) is a common

Table1. Recommended Spacing of Vine Crops

Crop	Distance Between Plants	Distance Between Rows
cucumbers	8 cm (3 in.)	1.0-1.2 m (3-4 ft)
summer squash	76 cm (30 in.)	1.2-1.8 m (4-6 ft)
bush pumpkin and winter squash	1 m (3 ft)	1.5-1.8 m (5-6 ft)
vine pumpkin and winter squash	1.5-1.8 m (5-6 ft)	1.5-1.8 m (5-6 ft)

problem, however, it is the only planter that will seed through plastic mulch.

Rising seed costs have increased the popularity of vacuum seeders. The Garpardo is so precise that nearly perfect single seed placement can be achieved. Single seed placement in summer squash, pumpkin and winter squash is important because high plant densities can have detrimental effects on production and disease unless some manual thinning is done.

Unusually high plant densities delay maturity, reduce the quality of fruit and increase the incidence of disease, particularly Sclerotinia, which prefers the shady and damp conditions found under thick leaf cover. Plant population density studies in vine crops have not been conducted in Alberta. Based on commercial field observations, the spacings given in Table 1, are generally recommended

Use of Plastics

Plastic mulches, plastic row covers and most recently, floating mulches, have a significant effect on improving earliness and yield of vine crops. These materials heat the soil and surrounding air, stimulating plant growth early in the spring season when soil and air temperatures are the coolest.

Plastic mulch is usually manufactured in rolls that are 1.2 m (4 ft) wide and of variable length. When applied, approximately 10 cm (4-6 in.) on both sides of the roll are buried in the soil to anchor it. This remaining width will give an exposed surface approaching 1 m (3 ft) through which seeding can take place. The tractor mounted mulch layer machine, if properly adjusted, will do an excellent function of laying plastic mulch. Of particular importance to note is that mulch should only be applied to a moist soil. The usual practice is to rototill the soil smooth and level, then shortly after lay down the plastic mulch. If the soil is dry, an irrigation may be required before rototilling. It is difficult to improve soil moisture levels under the plastic once the mulch has been applied. Plastic mulch layed down several weeks before seeding will trap spring soil moisture reserves and also warm the soil in advance of seeding.

Both black and clear plastic mulches have their advantages and disadvantages. Black plastic mulch heats the soil less effectively than clear plastic mulch, but it does control weeds. Because clear plastic will not control weeds, a herbicide must be applied before the mulch is layed down. Research has shown that herbicide activity improves under clear plastic compared to an unmulched soil. The recommended rate of herbicide should be applied first, then the plastic mulch should be layed down. Seeding should take place at least one week after the herbicide is applied to the soil. No herbicide incorporation is required if the mulch is applied on the same day as seeding takes place. This is the recommended practice.

The plug-mix planter is currently the only tractor-mounted machine used in Alberta that seeds through plastic mulch (refer to seeding section for details). Walking sticks or jab planters, which are manually-operated, do an adequate job in small acreages. Often called a potato stick planter, the walking stick is inexpensive and can be used to seed any large-seeded crop.

Once frost has killed the vines, all plastic mulch must be removed manually or by machine using a mulch lifter because the plastic will not decay. Photo-degradeable mulches have been shown to be unsuitable in Alberta. A mulch lifter machine, in one operation, undercuts the buried edges of the plastic mulch and either rewinds the plastic on to a roller or simply lays it back down on the ground. Whatever lifting sytem is used, the plastic mulch is not reuseable in the field.

To further enhance growth and production, plastic row covers can be erected over the plastic mulch after seeding. It is important to remember that once seeded, the crop should be irrigated at least one time before a row cover is erected. It is

very difficult to water-in seed through a row cover. Also, row covers must be used in combination with plastic mulch because soil drying and weed growth become major problems without the mulch. Row cover plastic is clear and comes in rolls measuring either 1.5 or 1.8 m (5 or 6 ft.) wide with ventilation holes 2.5 cm (1.0 in.) in diameter every 15 cm (6 in.) in length and width of plastic. Producers in windy areas should not use row cover plastic that has parallel slits for ventilation because of problems with tearing which do not occur if holes are used for ventilation. Wire hoops arched over the plastic mulch support the row cover. Galvanized #9 gauge wire cut to 1.5 or 1.8 m (5 or 6 ft.) lengths are placed manually or by machine at 1 to 1.4 m (3 to 4 ft.) intervals. Row cover machines unroll the cover plastic over the wire hoops and finally secures the plastic to the soil by buring the edges. This can also be done manually. The row cover must be secure and very tight fitting to prevent wind damage from occuring to the structure. A nylon string held taut between secure pegs can be used in place of wire hoops and the resulting lower height of the row cover offers less resistance to wind and its damaging effects.

Emerging seedlings spread their roots rapidly under and beyond the edge of the plastic mulch. Overhead sprinkler irrigation is adequate for providing moisture to the plants once they are established. Ventilation is maintained through the vent holes of the row cover and sometimes mid-day wilt may be observed on hot days because of the high temperature under the cover.

Bees will not fly under plastic to pollinate flowers; therefore, the row cover must be removed once flowers begin to appear. Remove the cover on a cloudy day to minimize shock to the plants as they adjust to a natural environment.

It is important to note that plastic row covers do not offer any protection against frost, however, floating mulches do. Floating mulches are generally made of a spun-bonded polyester material that is very porous to air, light and water. It eliminates the water penetration and heat build-up problem common to plastics. Up to 2°C of frost protection can be expected. Floating mulches are designed to be laid loosely over a growing crop, the edges anchored down by soil or rocks. As the crop grows, the loose mulch lifts with the crop canopy providing a warm, sheltered environment. Weeds also love this environment and have been one of the major problems associated with floating mulches. Some abrasion of plants also occurs under windy conditions. Like plastic row covers, floating mulches must be removed to allow for pollination of flowers by bees. Floating mulches work best if they are used like a row cover supported by wire hoops.

Weed, Insect and Disease Control

Weed control, through the application of herbicides, is difficult to achieve in vine crops. Even the few herbicides that are registered provide limited control. The producer is advised to refer to the current issue of the Alberta Vegetable Production Guide for herbicide recommendations. A good crop rotation scheme will do much to reduce weed problems. Also, because the seeding of vine crops must be delayed until soils warm to 15°C, an early spring irrigation before seeding will encourage weed germination. The seedbed should then be tilled one last time just before seeding. The use of black plastic mulch is also an option available to control weeds.

Alberta producers of vine crops are not affected by any problem insects that hinder production.

Angular leaf spot and Sclerotinia cause some concern as disease problems. Angular leaf spot is introduced through infected seed and overwinters on infected plant debris. Cucumbers are particularly susceptible to angular leaf spot. The identifying feature of this disease is water-soaked areas on the undersurface of leaves which become angular in shape. Humid conditions favor disease development. A 3-year crop rotation program, copper spraying at 5 to 10 day intervals and use of resistant varieties are good preventative measures.

Sclerotinia fruit rot shows up in storage where infected fruits are stored under humid conditions. Fruit lying in the field comes in contact with infected soil and in storage the fruit rot progresses. A 3- to 4-year crop rotation scheme is required to lessen the problem and dry harvesting weather will do much to control the disease. Above all, proper storage conditions are required (refer to storage section for details).

Irrigation

Vine crops have a broad spreading, shallow root system that forages for moisture close to the soil surface. They are sensitive to lack of water and the general rule is that 25 to 50 mm (1 to 2 in.) moisture is required every week to promote growth. In water deficit conditions, large fruit have priority for available water while smaller fruits, which are

unable to compete successfully, usually abort or become disfigured. In cucumbers, lack of moisture or variation in moisture causes fruit bitterness. Fruit bitterness is more extensive at the stem end and can be found just under the skin, but never in the interior of the fruit. Once bitterness develops in fruit, it cannot be eliminated. Maturity in pumpkin and winter squash fruit can be enhanced with irrigation water if no water is applied after mid-August. Dry field conditions also hinder disease development and speed up vine dieback, which assists harvesting.

Special Problems

Seed Loss in the Field

A peculiar problem, particularly with pumpkin and squash, is rodent and bird damage to seed shortly after it is sown. Seed is dug out of the soil and eaten with only the seed shell left in the field as evidence of damage. The problem occurs right up to emergence and is more prevalent along field borders. The rodents are very hard to control, however, small piles of seed left on the soil surface in the field as bait helps reduce the severity of the problem.

Wind Damage

Foliage damage caused by wind reduces productivity of vine crops, which prefer a warm, sheltered location. Fields bordered by trees provide ideal protection, however, trees take years to establish and may interfere with cultivation and irrigation equipment.

Several crops can be used to provide wind shelter (see Table 2).

Pollination

Vine crops must be pollinated by bees. The general recommendation is to supply one bee hive for every acre of vine crop. Bees are most active between 10:00 a.m. to 3:00 p.m., therefore, during heavy bloom periods irrigation should be avoided during these hours so as not to hinder bees activity. Research has shown that each female flower should have between 10 and 12 bee visits for complete pollination to ensure fruit is uniform and smooth in

Table 2. Shelter Crops That Provide Wind Protection

Shelter Crop	Advantages	Disadvantages
winter cereal	early spring growth maximizes shelter effect	tends to lodge under heavy rain or irrigation, late harvesting will result in seed shattering and causing a new weed problem, must be sown in September
spring cereal	maximum shelter effect is late in the season	late spring growth provides little shelter when winds are most prevalent
corn	maximum shelter effect is late in the season, crop is marketable	late spring growth provides little shelter when winds are most prevalent
sunflowers	maximum shelter effect is late in the season	late spring growth provides little shelter when winds are most prevalent, may attract birds that could be a nuisance
dill weed	maximum shelter effect is late in season, most advantageous if sown in fall, crop is marketable	late spring growth provides little shelter when winds are most prevalent, may introduce a new weed problem

shape. Close proximity of vine crops to canola and alfalfa fields is not recommended because of the extra competition for bees during peak bloom periods.

Most new varieties on the market are hybrids. Because vine crops are cross-pollinated, saving seed of hybrids is not recommended. The seed of non-hybrids may be saved if isolated from members of the same species by at least one mile. Pickling and slicing cucumbers will cross-pollinate with each other but not with pumpkin and winter squash. Pumpkins will cross pollinate with all summer squash varieties as well as acorn, spaghetti and ornamental winter squash varieties. The hubbard, buttercup and delicious varieties of winter squash will only cross pollinate with each other.

Acorn squash varieties are particularly sensitive to cool weather. Flowers will appear but no fruit will set. What little fruit does set will fail to develop properly. Nothing can be done to improve the situation.

Harvesting, Handling and Storage

Cucumbers

Cucumbers are hand harvested, often with the assistance of a picking aide. Most picking aides have pickers either sitting or lying down as they pick fruit from a mobile platform mounted on an old car frame that is driven by a motor with a creeper gear. Pickling cucumbers are generally picked on a 2-day cycle, then the fruit is packed into cardboard boxes in 11.3 kg (25 lb) units. The ideal fruit size is between 2.5 and 4.0 cm (1.0 and 1.5 in.) in diameter and at least 5 cm (2 in.) in length. Slicers yield well if they are picked every 4 to 5 days. A count of 24 fruit is packed into each cardboard box. The ideal slicer cucumber is dark green, at least 15 cm (6 in.) in length and 2.75 cm (1.25 in.) in diameter. In both pickling and slicing cucumbers, the fruit must be uniform in size and shape with a minimum amount of tapering at the blossom end. Dirty fruit should be washed.

The fruit must be cooled immediately after picking and held in a cool area prior to and during shipping. The ideal holding temperature is about 7°C. Colder temperatures induce chilling injury. High humidity is required to prevent dehydration. Produce should not be held in storage for longer than a two-week period.

Summer Squash

The fruit of summer squash are hand harvested on a daily basis, particularly during hot weather. The fruit is cut off the plant with a knife; a portion of the stem must remain attached to the fruit. The fruit is extremely tender and subject to bruising and puncture, so it must be handled carefully. The fruit is packed by weight, 11.3 kg (25 lb), into cardboard boxes and cooled immediately. The marketability of the pack is improved if all the fruit is uniform in color, size and shape. Crooked fruit is not marketable. Harvested fruit should be stored at 7°C to prevent chilling and high humidity to reduce dehydration. The product should not be held in storage for more than one week.

The more often fruit is harvested, the higher the production. Summer squash suffers from "first fruit" inhibition where the first fruit that is set inhibits additional fruit set. It is important to harvest every day and also to cut off all oversized fruit. Cull fruit must be removed from the field. Rotting cull fruit generate a soft rot fungus that infects growing fruit, and once harvested the disease will flare up in storage and during fruit shipment.

Pumpkin and Winter Squash

Mature pumpkins are orange. Winter squash, when fully ripe, produce a rind that cannot easily be punctured. For the early market, vine growth can hinder the harvest because fruit is not easily located. A light frost that nips back the foliage greatly assists harvest. The fruit is hand picked and stacked in bins, usually made of wood, that allow for uninhibited air circulation. Storability is greatly enhanced if fruit is cured at of 30°C for 10 to 14 days under conditions of high air circulation. Curing dries the fruit and heals wounds. Holding temperatures of 10 to 12°C are required for long-term storage where relative humidity does not exceed 70 per cent. Temperatures above 15°C lead to high respiration rate, which results in weight loss and quality deterioration. Even under ideal storage conditions, a 3 to 5 per cent weight loss per month can be expected.

The market for pumpkin is tied directly to Halloween. Despite its longer storage capability, the market for pumpkin collapses after Halloween. Pumpkins are usually marketed in bulk tote cardboard bins holding up to 500 kg (1100 lb) of fruit. Stems must remain attached to all fruit. For winter squash, the market is dependent on cold weather and markets generally improve as winter advances. The healthy good storage facility in this case becomes ever more important. Squash type

has a big influence on fruit storability. Acorn squash is the most popular, unfortunately they are not good keepers beyond eight weeks of storage. The green color breaks down and fruit turns yellow. Buttercups are also popular and all varieties store very well as do banana and spaghetti squashes. Hubbards store the longest, but because of their large size and tough skin, they are not popular in the market-place. Fruit disinfected in wash water containing 1 part household bleach to 6 parts water will help extend storage life.

Small fruited squash should be marketed in 11.3 kg (25 lb) lots in mesh bags. Large fruited squash are sold in bulk cardboard tote bins weighing up to 500 kg (1100 lb). Bulk shipments of fruit are more subject to pressure bruising and decay. Most wholesale warehouses are not equipped to hold winter squash for long periods of time because warehouses tend to be cool and damp rather than warm and dry. Fruit rot in warehouses is common and frequently causes financial loss to the producer.

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